Variable air volume (VAV) systems are very popular in many modern buildings. One important benefit that VAV systems offer is low operating cost at part-load conditions. In a VAV system, air volume delivery rate varies directly with the cooling or heating load. Less air is needed at part-load conditions, so less fan horsepower is required. Mechanical cooling requirements also vary directly with the cooling load.

The key to maximizing part-load horsepower savings is proper control of fan capacity and mechanical cooling capacity. How can a VAV system be controlled to maximize part-load energy savings without sacrificing zone comfort? Is there a way to optimize fan capacity and cooling capacity, and at the same time, make the VAV system more reliable, easier to design and install, without adding cost? Let’s find out.
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A Simple VAV System

Let’s start with a very simple cooling system as we try to answer these questions. An elementary VAV air delivery system with only a single zone is shown in Figure 1. Although unrealistic, this simple system serves to illustrate VAV system operation. Air from the occupied zone enters the return duct system, then returns to the central variable air volume supply fan mounted in a rooftop air conditioning unit.

The fan adds mechanical energy to the air stream, increasing its total pressure, while the cooling coil removes heat from the air stream. The amount of energy added by the fan is variable, and is usually modulated with fan inlet vanes or a variable-speed drive on the fan motor. The amount of heat removed by the cooling coil is also variable, and is usually modulated in response to the supply air temperature. Supply air is delivered to the VAV terminal unit via the supply duct system. The VAV terminal unit adjusts the volume of air delivered by modulating the position of a damper or air valve. Finally, the air travels from the terminal unit through the downstream ducts and diffusers, and once again enters the occupied zone.

The fan curve, brake horsepower curves for 100-percent-open inlet guide vanes, and the duct system resistance curve for our simplified system are shown in Figure 2A. Figure 2B shows the static pressure gradient throughout the entire air path. (At partially closed vane positions, the horsepower curves actually shift downward, but this effect is ignored in the following discussion. Consequently, all energy savings values calculated are somewhat conservative.) The fan, a dual-inlet 20×20 FC fan with inlet guide vanes, operates at 1,000 rpm and is mounted in a 40-ton rooftop unit. Duct system resistance is determined by the supply and return ducts, as well as the coils and filters in the rooftop unit, and the VAV terminal unit.

For this discussion, we’ll assume that the static pressure drop through the system is 2.70 in. wg at the design flow of 24,000 cfm. At design flow, the VAV terminal unit at the zone is fully open, as are the fan inlet guide vanes. The fan operates at the intersection of the fan curve and system resistance curve, Point A, using approximately 23 brake horsepower (bhp). The various system components reduce the static pressure as shown in Figure 2B. The fan static pressure is 2.70 in. wg, while the duct static pressure—measured with respect to the ambient pressure—is 1.40 in. wg.

As the cooling load in the zone decreases, less airflow is needed. As shown in Figure 3A, if no fan modulation is used, the terminal unit closes to reduce the airflow and a new system resistance curve results. The fan operates at the intersection of this new system curve and the fan curve, Point B. In our simple system, closing the terminal unit to reduce airflow from 24,000 cfm to 18,000 cfm, a 25 percent...
reduction in airflow, increases fan static pressure to 3.15 in. wg, increases duct static pressure to 2.42 in. wg and decreases fan brake horsepower to 18. As Figure 3B shows, pressure drop through the ducts, fittings, and rooftop unit decreases, while the pressure drop across the VAV terminal unit rises from 0.30 in. wg to 1.80 in. wg.

**Fan Capacity Control**

When inlet guide vanes are used to modulate fan capacity, as in our simple example system, fan static pressure is reduced at part-load airflow and additional horsepower reduction is possible. The magnitude of the fan static pressure and horsepower reductions depends upon the method used to position the inlet guide vanes and thereby control fan capacity. Note that as fan capacity is reduced, airflow through the coil is reduced and less mechanical cooling is needed to maintain the supply air temperature set point. Traditionally, inlet guide vane position is determined by a static pressure control loop consisting of a duct static pressure sensor, static pressure controller and inlet guide vane actuator. Duct static pressure is sensed at some location in the duct system and transmitted to the controller. The controller compares the sensed pressure to a set point pressure and modulates the inlet guide vane actuator to maintain a constant duct static pressure at the sensor location. The location chosen for the sensor and operation of the controller determine the system first cost, installed cost, and overall reliability, as well as fan static pressure and operating cost. Let’s examine and compare three static pressure control methods:

- Fan outlet static control
- Supply duct static control
- Critical zone reset

Trane believes the facts and suggestions presented here to be accurate. However, final design and application decisions are your responsibility. Trane disclaims any responsibility for actions taken on the material presented.

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808.845.6662
- Create marketing budget annually. Set marketing goals for the year; review and adjust quarterly.

- Participate in at least one sales/marketing activity daily (call or email a target/customer, host an education session, etc.).

- Stay in touch with trends that impact your industry and target market. Read The NEBB Professional!

- Join NEBB’s LinkedIn group and others related to your target market. Be active on social media.

- Submit company highlights, including projects completed and other achievements (50th client/project of the year or other notable milestone), to NEBB national marketing so it can be sent out as a press release or included in Program News and/or The NEBB Professional getting your company visibility in the industry.

- Submit technical article to The NEBB Professional and other industry publications. Circulate reprints of published articles you authored or photocopy interesting articles and send them to clients and prospects with a hand-written note and your business card.

- Get a booth at an industry trade show attended by your target market. When NEBB national is exhibiting at an industry tradeshow in your local area, volunteer for NEBB booth duty. This is an excellent way to promote NEBB and your firm to your target audience.

- Display customer testimonials in your brochure, office and website.

- Create a signature file for all company email messages. It should contain contact details, including company website and a key message about your company/service that will make the reader want to contact you.

- Talk to employees, customers and others in your network (attorney, accountant, banker, printer, supply salesperson, temp agency, etc.) to promote referrals.

- Best way to generate more business is to ask for it. Talk to clients about the services you provide that they aren’t currently utilizing.

- Always carry business cards. You never know who you’ll run into!

This article was published in the Fall 2013 issue of The NEBB Professional. This article has been republished with permission from NEBB.
What Is Your E-Signature?

As living creatures, we are an expression of Energy. Our Energy is demonstrated by our thoughts, words, and actions. Our thoughts, words, and actions have an influence upon ourselves, others, and our environment. Most simply stated is that positive Energy will have a positive influence. Negative Energy will not have a positive influence.

Thoughts are real things! Science has equipment which can identify and measure that thoughts are Energy. Positive thinking makes us feel better and will stimulate positive physical responses within our bodies. Our words are more ‘apparent’ as a form of Energy. Words spoken kindly, with positive intent, have a positive influence upon oneself and others. Written words have a special magic! When a person writes a word, their Energy which began as a thought is transferred into the written word and every time that the written word is read, Energy is transferred to the reader. This also applies to the ‘recorded’ word as well. Actions which are apparent as Energy make an observational impact upon the environment and others. Often remains of our influence are observable.

We ALL have an influence upon ourselves, others, and the environment. As we ‘interact’ with others (and the environment) we leave remnants of our interactions. Those remains or influences might be called our Energy Signature, E-Signature.

All of us have influence! This includes and not limited to people who are involved with: bodywork, housework, woodwork, artwork, homework, customer service, food service, social service, military service, health care, hair care, family care, animal care, education, business, play and much more.

Every thought, word, and action has influence upon us, others, and our environments. It is vital that we take to heart the ‘message’ we leave behind. Simply stated, a friendly greeting, a warm smile, and an appropriate touch have positive influence. That influence remains often after we depart from a person or situation. Remember the influence of your E-Signature.

By Loren D. Lasher
Potential Development, Unlimited
loren@lorenlasher.com
Pyramid Balancing Associates, Inc. located in Santa Clara provides owner direct test and balancing services focusing on the high tech industry, micro-electronic, FABS, hospitals and bio-labs.

Dan Moore, President of Pyramid Balancing Associates, Inc., along with a business partner, started the firm in 1996 and was located in San Jose. They started the company as an alternative to the “plans bid” type of contractors working in the industry. Dan and his partner noticed the need for a test and balance company to take ownership and responsibility for the ongoing needs of micro-electronic labs in the area. With the fast pace of the high-tech industry, the labs are constantly being modified to allow installation of new equipment. The ever changing mechanical system(s) of the labs poses numerous challenges for the TAB firm, and by having a technician on site who is extremely familiar with the site has allowed Dan to provide their clients construction teams, and engineering staff with ongoing current operating data of their facilities. This has allowed them to provide fast turn-around and minimize construction issues. In addition to the constant remodeling of the labs, Pyramid Balancing Associates, Inc. performs annual code compliance verification of the exhaust air systems.

In 2000, Dan bought out his business partner to become sole owner of Pyramid Balancing, Inc. At that point in time the firm moved to an office space in Santa Clara and with the exception of a satellite office in Pleasanton, has maintained their office in Santa Clara. Currently they are looking to expand their office space as they are quickly out-growing their current location.

Along with Dan Moore, Pyramid Balancing Associates, Inc. has five (5) employees, four (4) technicians and one (1) office administrator. His
office administrator, Denise, has been working for the firm since 2001 and handles payroll, billing, insurance, as well as day-to-day office administration. Dan handles estimating, bidding, supervising the work force and project management.

While attending Cal State Hayward, Dan worked for a Test and Balance firm. In 1985, he was offered a position with the firm and decided to make a career change and accepted the offer. Dan worked on numerous high rise office buildings, FABS, hospitals, micro-electronic projects and industrial projects. This wide range of projects allowed him to see many different types of HVAC systems, design concepts and controls, thus allowing him to develop a deep understanding of the needs and requirements of many industries. After working in this industry for 11 years for different firms, Dan felt the time was right for him to start his own business.

As a new start-up company, acquiring clients and projects was a challenge. Having his NEBB certification was a big help in getting Pyramid Balancing in the door as the NEBB certification and the association with NEBB, would lend credence to the firm. “Our NEBB certification got us in the door but our quality work keeps us working there.”


Pyramid Balancing Associates, Inc. has worked on many major projects in the Bay Area such as the Stanford University Medical Center, Bone Marrow Transplant laboratory, Stanford University Medical Center emergency department remodel, Hitachi Cleanroom manufacturing aisles, Applied Materials data center for mechanical commissioning, Philips Lumileds executive office suites, for test and balance & mechanical commissioning and USDA Western Regional Research Center, BIO-Level 2 Lab doing test and balance and mechanical commissioning, Linear Technologies Cleanroom expansions.

Dan feels his NEBB certification provides his clients with the knowledge that Pyramid Balancing Associates, Inc. is associated with a solid, well accepted independent professional industry testing association. Additionally, the continuing education opportunities through NEBB are extremely important to stay current on new industry developments, testing philosophies and protocols. A NEBB Certified Professional delivers experience, honesty, integrity, a vast knowledge base, and the ability to reach out to other NEBB certified professionals for technical assistance and knowledge.
This has been a very busy summer for this Chapter with a lot of activities. I would like to thank our chapter coordinator, Audrey Kearns for all of the time and effort she devotes to this Chapter. Between keeping up on membership housekeeping activities, all the various committees, and the local Chapter financial duties she is one very busy person for which we all owe our thanks to. So next time you see her, let her know how much you appreciate her support.

The Policy/Bylaws committee has been very busy. We have had several meetings and are moving forward to create some policy documents for this Chapter’s use going forward. Also, we are working toward some revisions to put before the voting membership in the spring to enhance our local Chapter By-laws. Martin Burke from TSS, Inc. is the chairman for this committee and I want to thank him and the rest of the committee members for their time and effort as this will be a challenging task to take on over the next year or so. Members are encouraged to keep up with the process by using the electronic file link provided to you by Audrey.

The technician ongoing education program is up and running so please take advantage of that as education is a cornerstone in this ever changing industry.

Bi-annual re-certifications are also here again and our technical chairman, Art DeLeon will be very busy with that process. Thank you Art in advance for the time and effort you will be putting forth to fulfill this very important Chapter position.

The nominating committee for your 2014 Board of Directors has been assembled and is hard at work to put forth a slate of candidates for election.

The marketing committee chaired by Amber Ryman has been busy selecting upcoming trade shows and advertisement opportunities along with acquiring some merchandising items. Thank you for all your hard work on this. Please contact Audrey if you would like a list of the items available.

For those of you voting on issues, please try to expedite your responses as we do have many things to move forward on and some must be done in a step by step fashion. So getting those responses quickly helps us move on to the next item.

I would also like to thank all of our members for your support over the past eight or so years during my service on the Board of Directors. As I vacate this position and assume the role of past president to support the incoming board members I wish them well and encourage them to provide representation of this membership with wisdom and tenacity for their positions.

I look forward to seeing everyone at our annual meeting in the East Bay in March. Best wishes and happy holidays to you and your families.

Curtis Worley
**2014 Chapter Annual Meeting**

Our 2014 Northern California/Hawaii NEBB Chapter Annual Meeting has finally been set. The meeting will take place on Thursday, March 27, 2014 at the Marriott Fremont Silicon Valley Hotel. Registration for the meeting is taking place now. All NEBB individuals, Certified Professionals, Technicians, Firm owners, industry leaders, customers, clients and guests are welcome to attend this meeting.

To get full details on this event and to register for the meeting, you can log onto our Chapter website at [www.nocalhawaiinebb.org](http://www.nocalhawaiinebb.org) and download the registration form. Early registration and a reduced registration fee is available until February 2, 2014. The cost will increase starting February 3, 2014 so get your form AND fees sent into the Chapter before February 2, 2014.

**Title 24**

Look for further information regarding Title 24 Certification with the CEC and a NEBB sponsored Title 24 training seminar sometime after the first of the year!
NEBB 2014 ANNUAL MEETING

The Marriott Fremont provides an elegant and accommodating atmosphere. The Silicon Valley encompasses a region of Northern California from San Francisco to Monterey Bay. Sporting events, museums, golf, shopping and wineries are all within a short drive. Great America theme park. The Tech Museum of Innovation. The Winchester Mystery house. Livermore Wineries. Mission San Jose to name a few.
Starting August 1, 2013 the Northern California/Hawaii Chapter will have available, voluntary on-line continuing education training for all our NEBB Certified Technicians. Currently technicians are recertified every 2 years at the same time that the firm and Certified Professionals are recertified. Technicians will need to accrue 6 hours of training each year to obtain a certificate for this voluntary continuing education program. If you choose not to participate then technicians will still receive recertification status under NEBB guidelines but no continuing education certificate will be issued in addition to the Certification Certificate issued by NEBB.

**NEBB Certified Technicians can accrue their 6 hours of training in the following ways:**

- Sign up through the Chapter for on-line training. The cost for this is $100.00. The NEBB Certified Technician will need to have read and studied the TAB Manual for Technicians, which can be purchased through NEBB to complete the on-line training and test. The on-line training is a randomized test covering the information in the manual. It is expected that the technician will have spent time before taking the test reviewing the manual as they will have only 6 hours to complete the on-line test. The 6 hours of training per year is expected to be made up of time spent on the test and time spent reviewing the manual. The technician will have 30 days to complete this Open Book test. Registration for the test is attached, or;

- They can attend the Chapter Annual Meeting, or;

- They can attend the NEBB Annual Meeting, or

- They can attend any NEBB sponsored educational seminar.

We intend to rotate between online training and hands-on training every other year. The Chapter has made the decision to offer this training for our NEBB Certified Technicians as part of their recertification options, in part, to further the knowledge and training of our technicians as well as meet the increasing demand from specifying engineers for up-to-date knowledge and understanding of the latest technologies used and their application in the TAB process.

Your input as the certified CP from your firm is needed to develop the training curriculum. We want to know the challenges your technicians are facing in the field regarding new devices and how to implement testing and balancing for them. For example, a couple of years ago VFD power exhaust systems started showing up on projects and additional training for our technicians was needed. The local Chapter addressed this need by facilitating factory training onsite. These are the type of items we want to hear about from our CP’s.

As this is a new feature (and an excellent marketing point) for our Chapter and your firm, we ask that you be patient during the first couple of years as we roll out this large undertaking. We know there will be challenges to working out the logistics. Please note that this program is not being funded from Chapter dues but is self-funded by those who participate. Any constructive input and time volunteered by you would further the advancement of this program. Thank you.
Upcoming Events

Northern California/Hawaii NEBB Chapter Annual Meeting

Thursday, March 27, 2014, 7:30 a.m.—5:00 p.m.
Fremont Marriott Hotel

Contact the NEBB Chapter Office to sign up or to receive more information

2014 NEBB Annual Conference

April 3-5, 2014
Hyatt Regency Pier Sixty-Six, Ft. Lauderdale, Florida

Contact the NEBB office to sign up or to receive more information

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